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# **Water Monitoring Systems: the Daphnia and Algae Toximeter under the Aspect of Quality Assurance and Routine Practice**



## Content

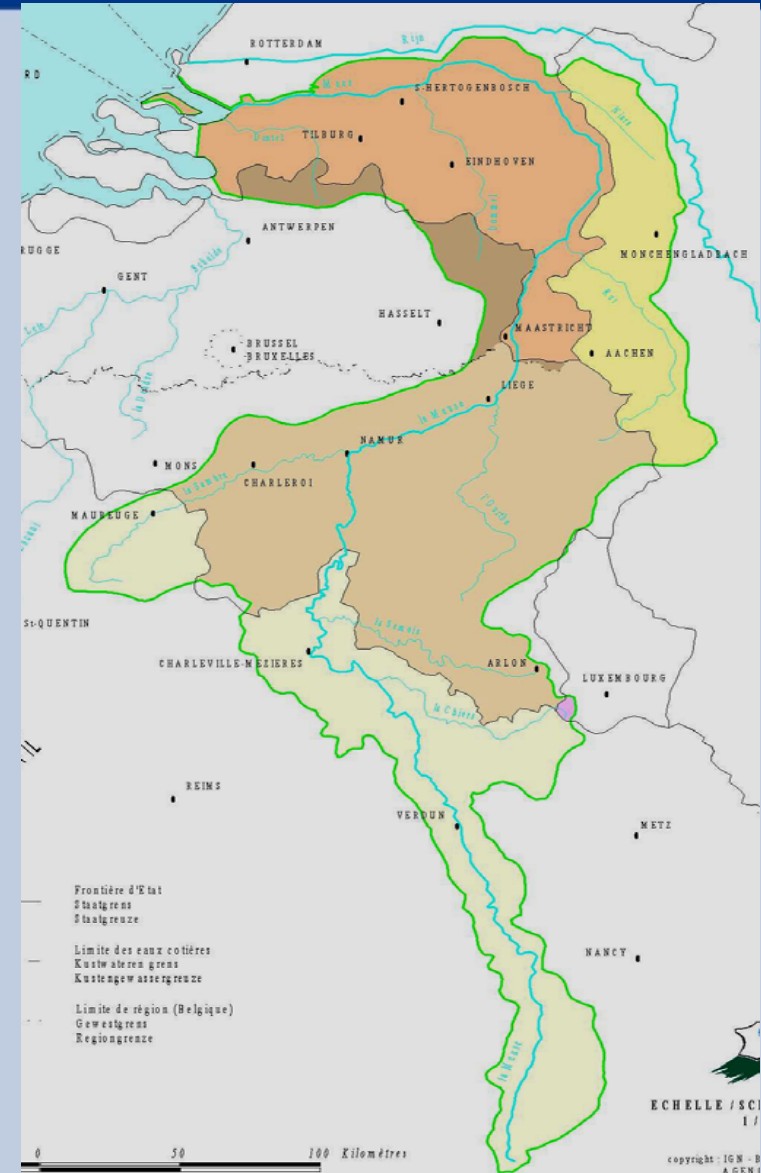
- **Location and mandate**
- **Experience of Dutch monitoring working groups with bbe Daphnia Toximeter**
- **Experience of Dutch monitoring working groups with bbe Algae Toximeter**
- **Alarm algorithms for different sensor data: the bbe AlViewer**



# The source: River Meuse

- Length: 900 km
- Average flow: 325 m<sup>3</sup>/s
- Basin area: 33,000 km<sup>2</sup>
- Population: 7.7 million

Water Storage Corporation  
Brabantse Biesbosch Ltd.





# Biological monitoring



- Continuous registration
- Acute toxicity
- Effects are measured (behaviour or physiology)
- Sensitive for a wide variety of compounds

**BUT**

- isn't sensitive for all kinds of compounds
- No alarm is no guarantee for the absence of all hazardous compounds



# Monitoring station Keizersveer

- Located upstream of the water-intake (response time)
- Monitoring during intake stop
- Continuous registration of T, O<sub>2</sub>, EC, pH and turbidity
- Measuring program (e.g. drinking water ordinance)
- On-line chemical monitoring
- On-line biological monitoring

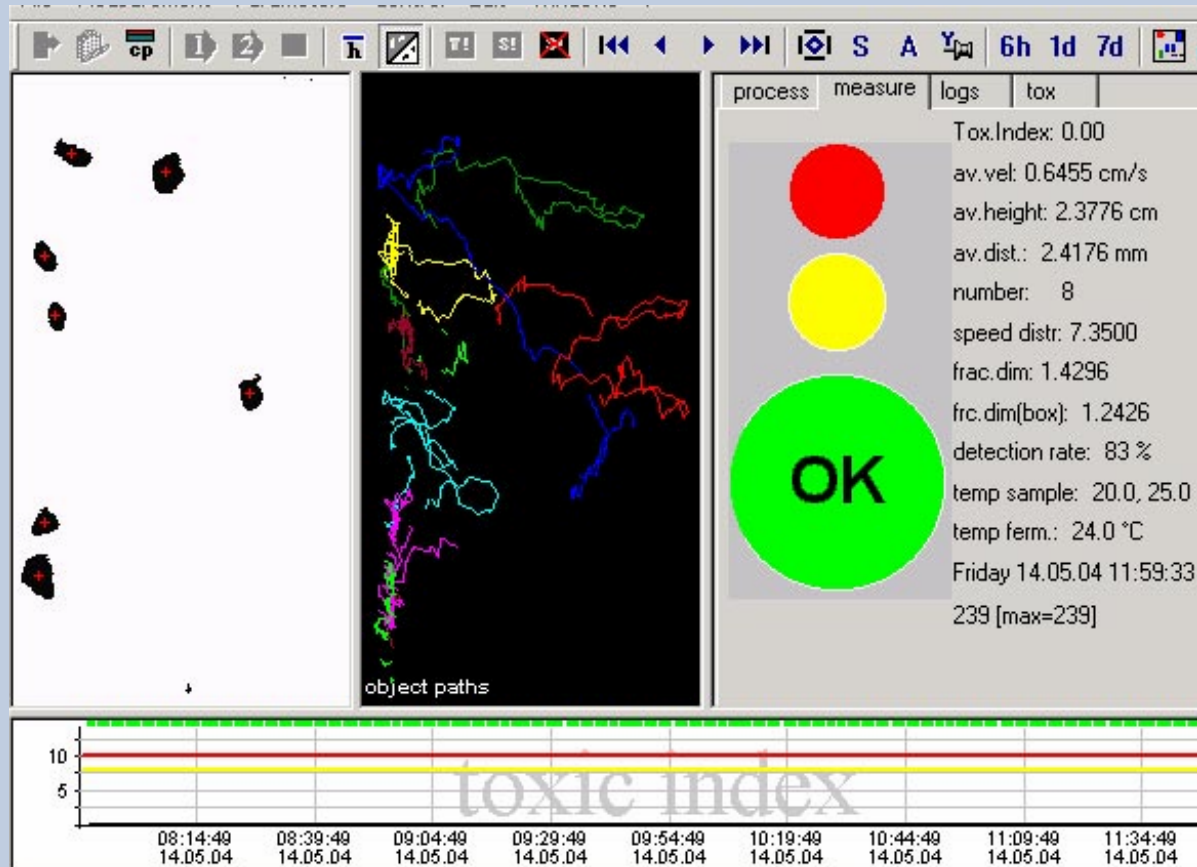




Mainly  
insecticides  
expected

Implementation

- trouble shooting
- validation
- quality assurance
- daily practice





# The bbe Daphnia Toximeter

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- **Technical status (daily registration)**
    - any failures registered by the system
    - number and size of the daphnids
    - air and particles in the chamber
    - temperature of sample, pre-heater and fermenter
    - detection or recognition-rate
  
  - **Maintenance**
    - additional
    - weekly
    - monthly
    - quaterly
- Operational availability > 90%**



# Validation: spike test with diazinon [1]

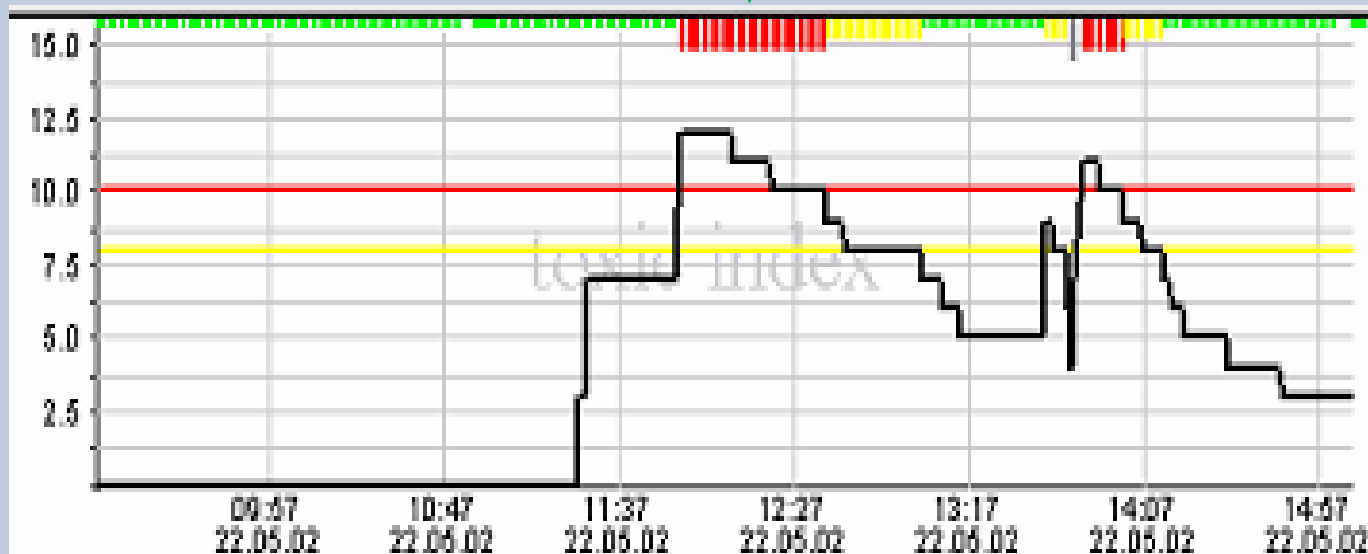
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Start

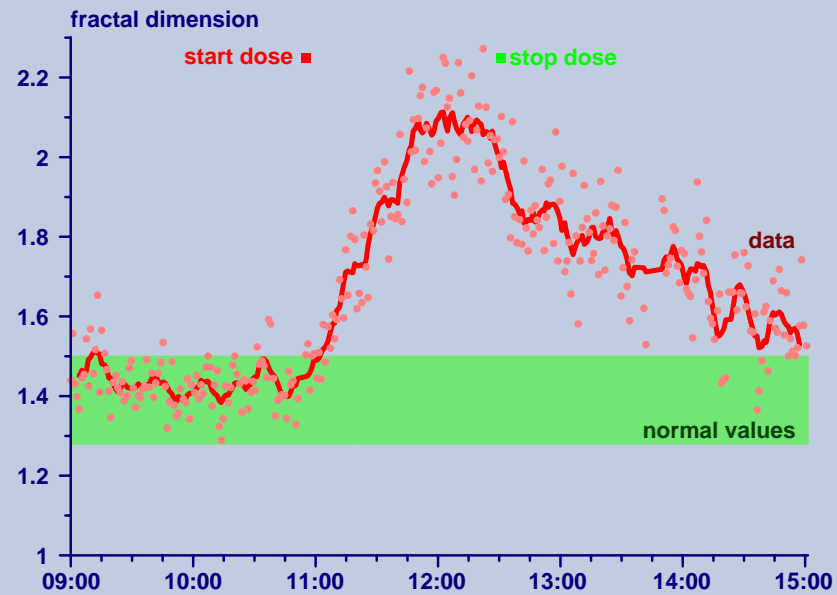
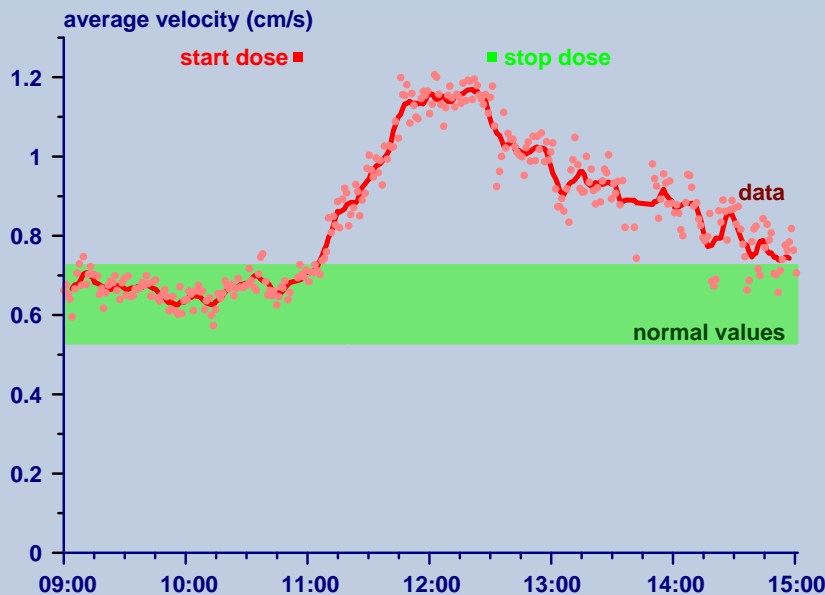
Stop

Toxic index





# Validation: spike test with diazinon [2]



- **Delay of alarm**
  - dead volume of the system (monitoring station)
  - response of alarm evaluating software
- **Alarms not permanent**
- **Alarms generated due to changing conditions**



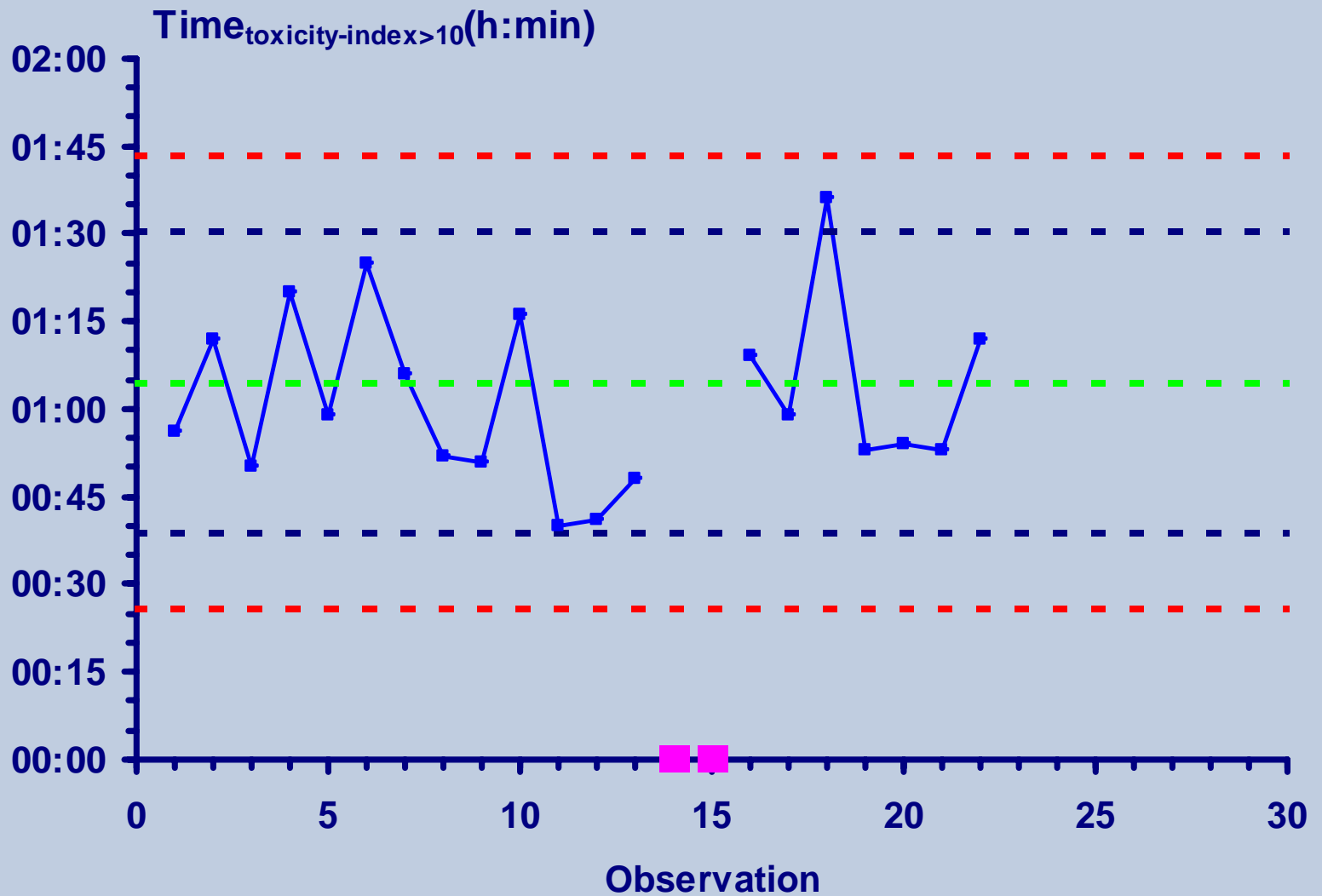
# Quality assurance [1]



- Quality assurance of total configuration
- Responses should be reliable and reproducible
- Control sample: 5 g NaCl/L
- Time to alarm is control parameter
- Evaluation of responding parameters



# Quality assurance [2]





# Procedure: alarm evaluation

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- **Evaluation of alarms**
  - **daily practice**
    - technical status
    - parameters causing the alarm
    - history and present parameter values
  - **results of other on-line detectors**
- **Minimum duration of intake stop: 24 hours**
- **Determination of the end of alarm**
  - chemical analysis
  - evaluate data with new batch of daphnids
- **Alarm is disabled after**
  - determined toxicant is below its limit, OR
  - data of daphnids are in “normal range”
- **Normal monitoring is restarted**





## **Experience of Dutch monitoring working groups with bbe Algae Toximeter**

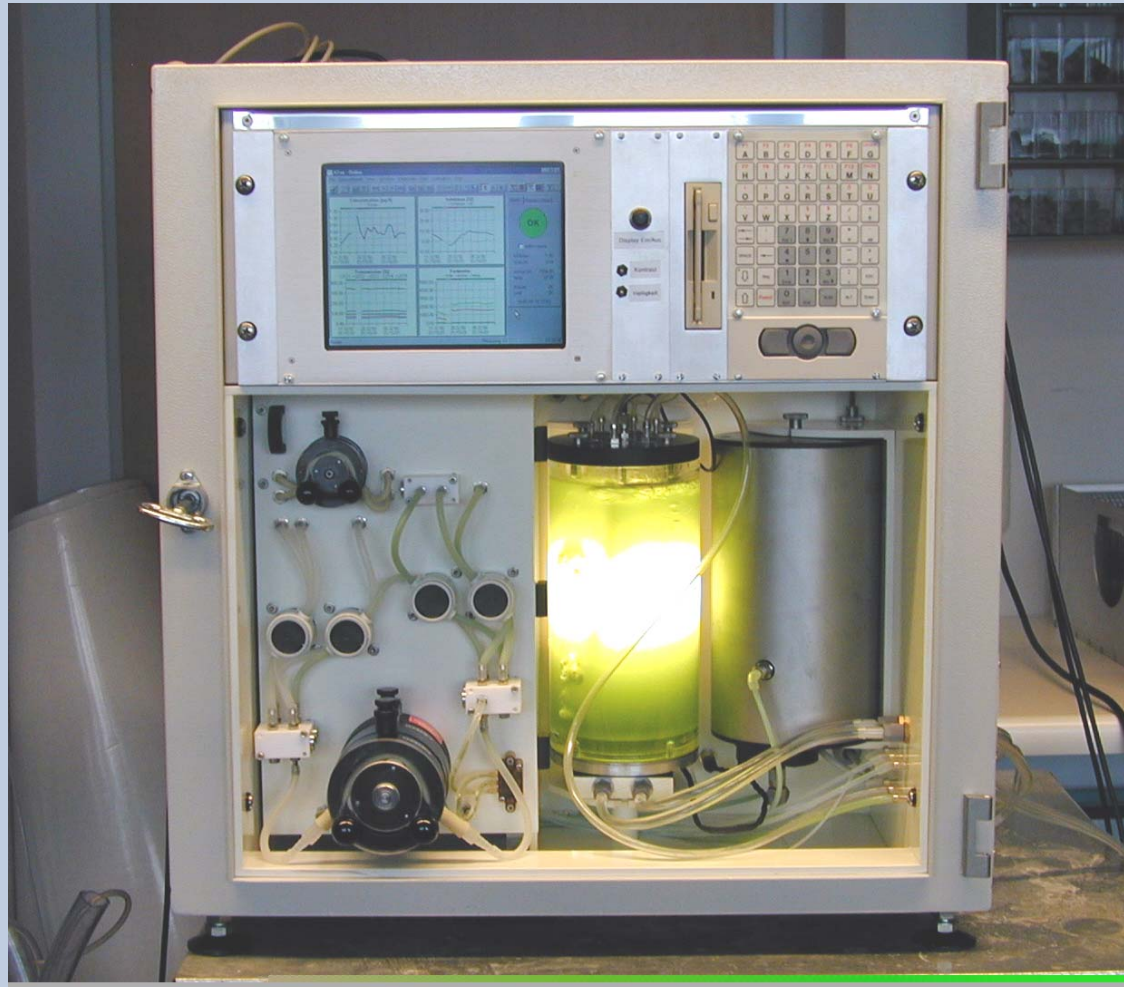




# bbe Algae Toximeter

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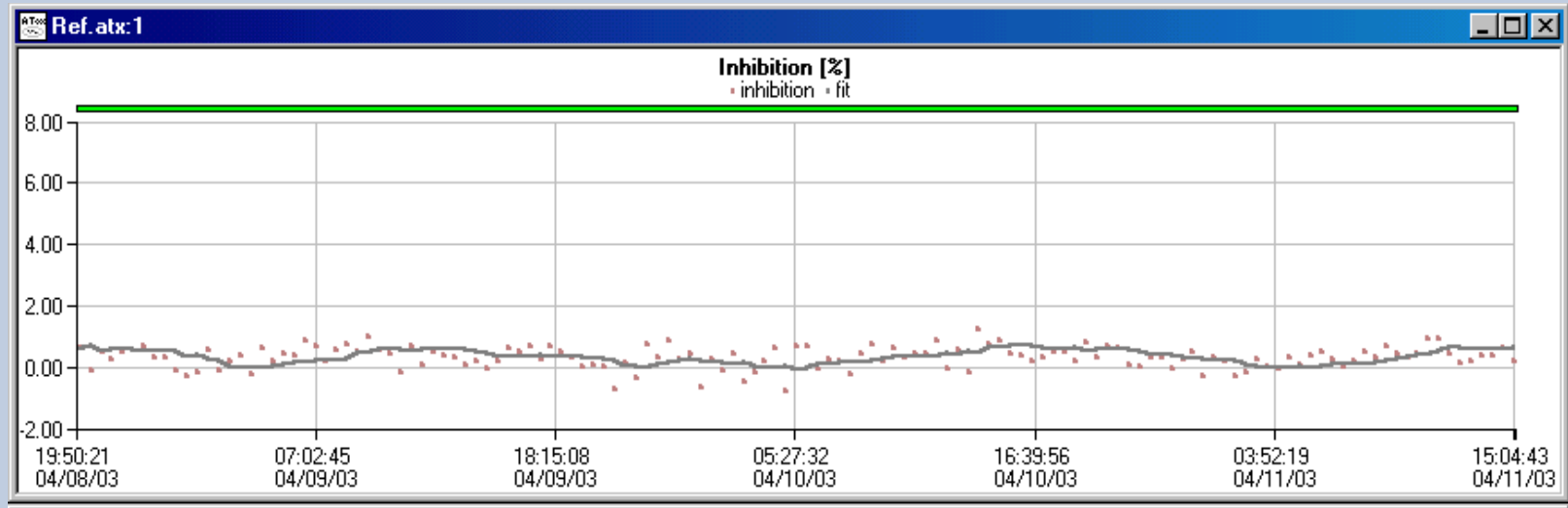




# Monitored Parameters of the bbe Algae Toximeter

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- Inhibition (reduction of oxygen evolution by fluorescence measurement)
- chlorophyll content
- algae class analysis (automatic determination of green algae, diatoms/dinoflagellates, cryptophytae, blue-green algae (cyanobacteria, more than 50% of all species of cyanobacteria are toxic))
- transmission



# Daily practice (Technical status)

## 2 checklists

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### ■ Technical status (daily registration)

- any failures registered by the system
- temperature of the fermenter
- transmission
- total and active chlorophyll of algae in the fermenter
- growth rate of algae
- dose rate of nutrients

### ■ Maintenance

- additional
- weekly
- monthly
- quaterly

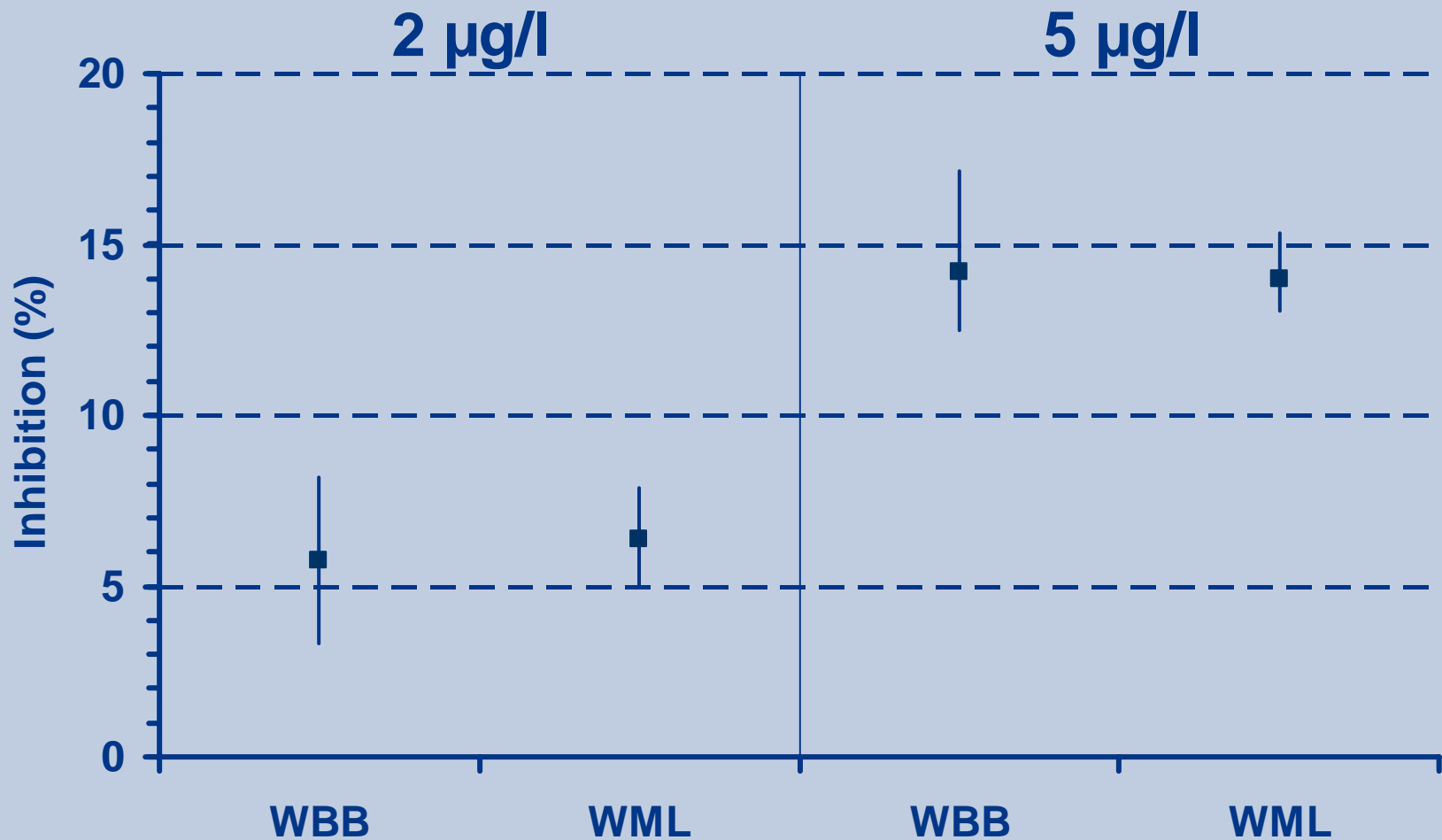
—————→ Operational availability > 85%



- **Water quality (checklist)**
  - **alarm (inhibition, Hinkley and limit)**
  - **inhibition**
  - **chlorophyll in sample**
  - **green algae, cyanobacteria, diatoms, cryptophytes**
  - **chlorophyll of sample compared with chlorophyll determined with Dutch standard method**



# Validation: spike tests with diuron





# Quality assurance [1]

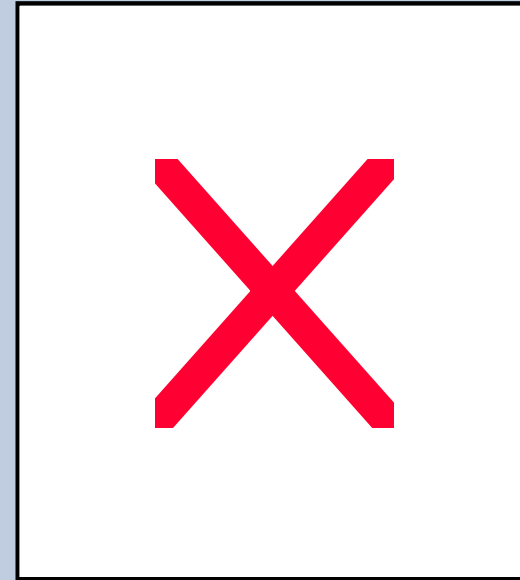
- Quality assurance of total configuration
- Responses should be reliable and reproducible
- Control sample: 2  $\mu\text{g}$  diuron/l
- Inhibition is measured for 2 hours
- Reference water test (reference connected as sample)
- Determination of noise



# Quality assurance [2]

- Microscopic of algae
- Determination of inhibition of control sample
- Determination of noise (reference water)

————→ Detection limit ( $3 \times \text{sd}$ )

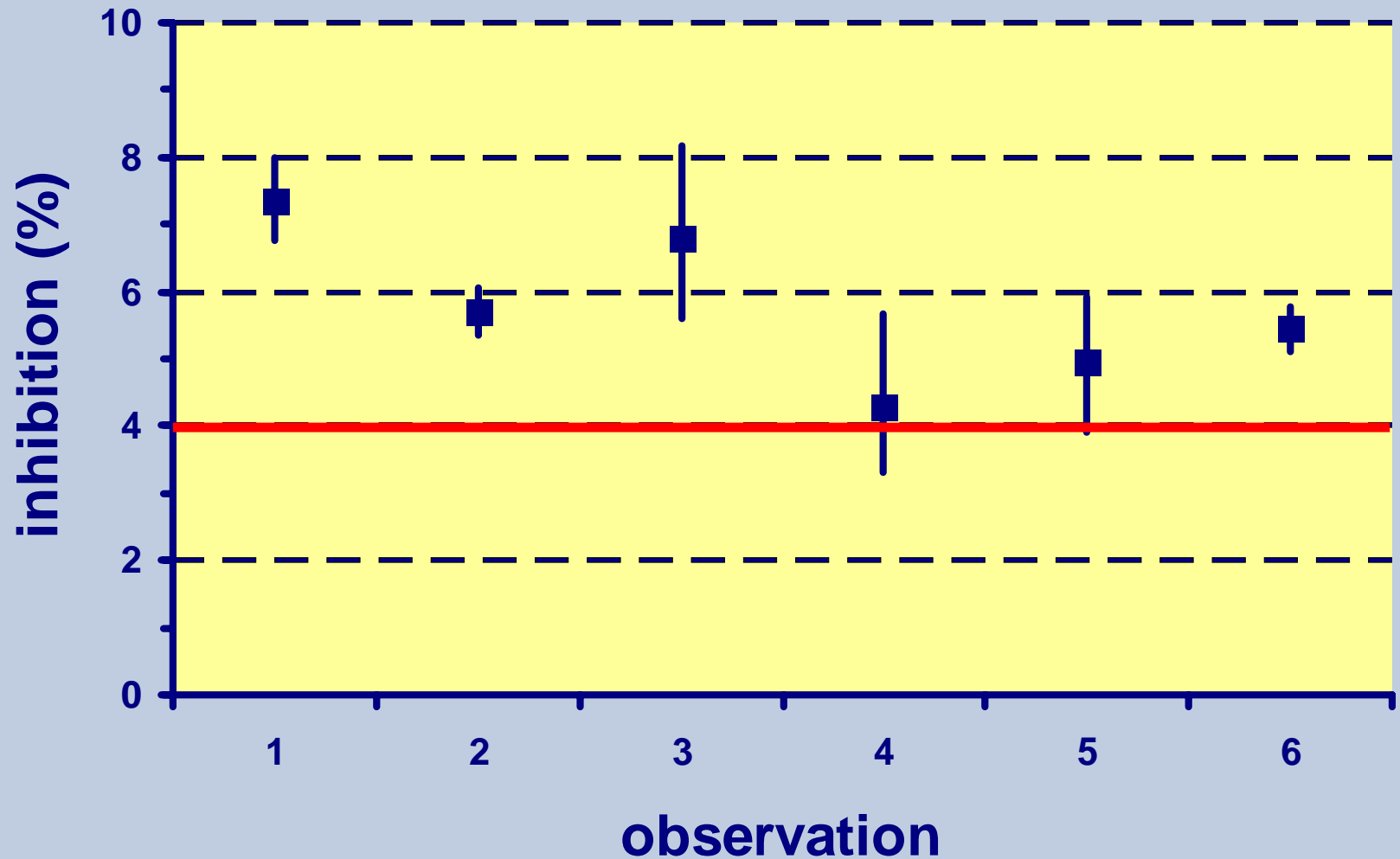


*Chlorella sp.*



# Quality assurance [3]

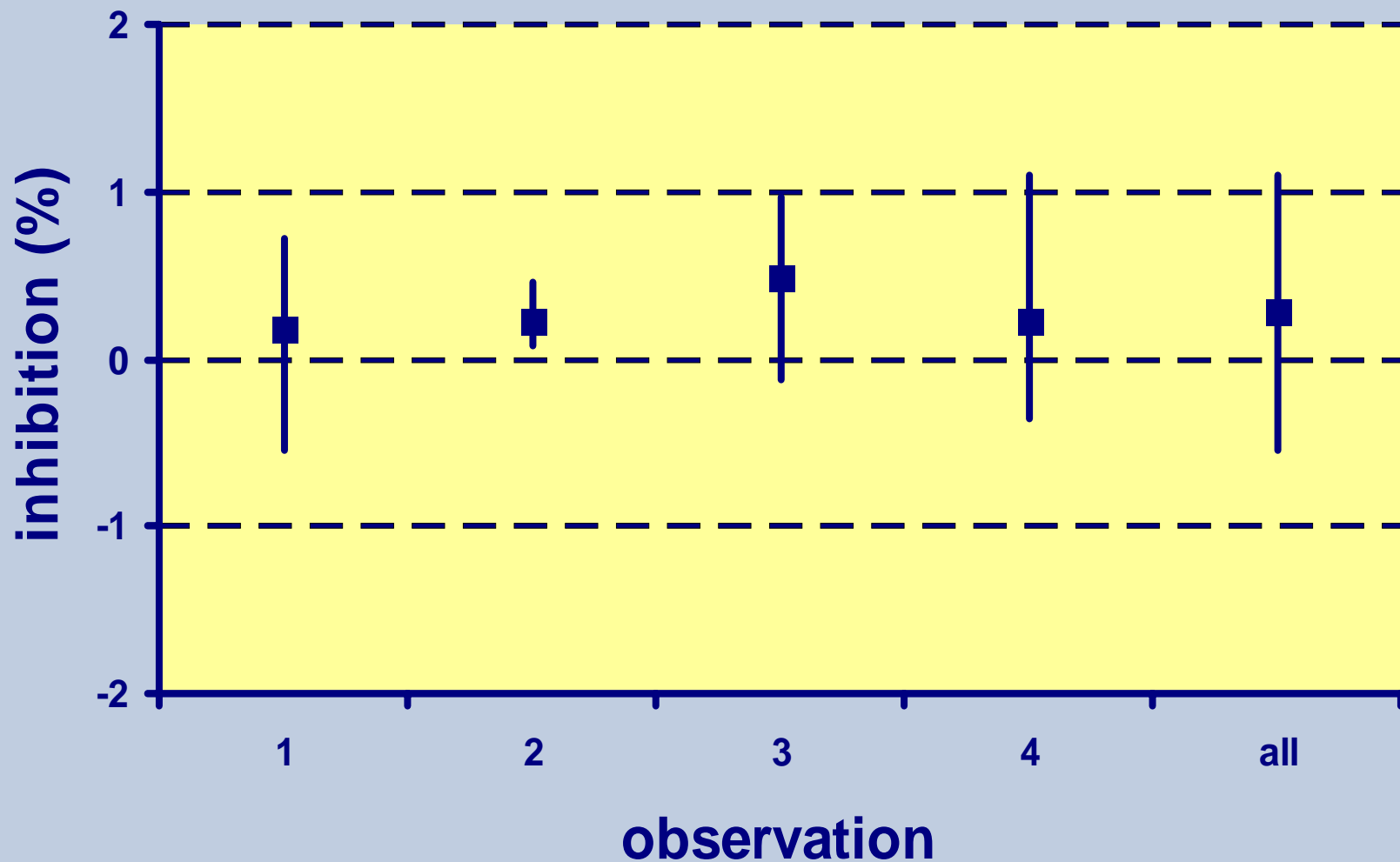
## Response of control sample





# Quality assurance [4]

## Determination of noise







# Knowledge exchange

- Dutch working group on operational aspects
- Dutch steering group on standardisation, validation and quality assurance
- Plans:
  - website
  - database with problems and solutions
  - thematic workshops
- Research in collaboration with AwwaRF and for the Dutch Ministry of Environment





# **The bbe ALViewer**

## **Multi Parameter Event Analyzer and Detector**

**Real time analysis for  
multiple sensor readings  
to detect significant  
events**



# Alarm Recognition from Traditional Sensors

a software which

- uses signals from various (existing) sensors  
like temperature, 254 nm-absorption), pH
- detects sudden changes in any signal
- combines the event evaluation from different signals to detect  
alarm events while also limiting false alarms
- compensates for drift (e.g. diurnal shift of temperature)
- is simply to include in existing data collecting systems

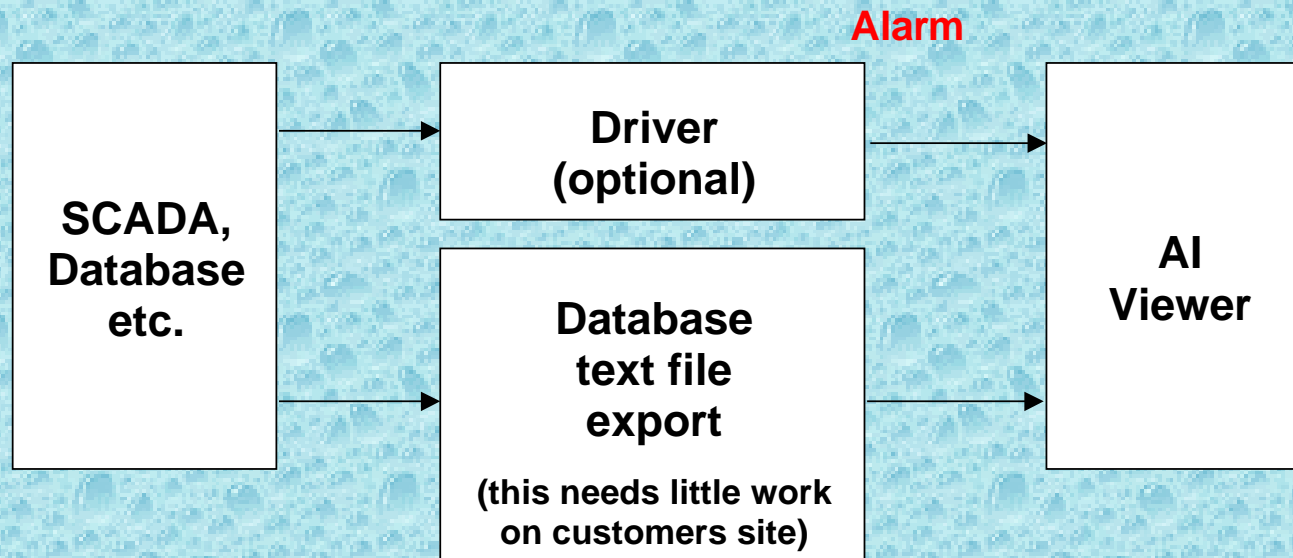




# Incorporation of the AIViewer in the Operational System

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## Text File Format

timestamp	pH	conductivity	Redox	Oxygen
	r.u.	$\mu\text{s/cm}$	mV	mg/l
dd.mm.yyyy hh:mm:ss	7.21	430	16.23	12.76





# Composition of the Alarm Index (AI)

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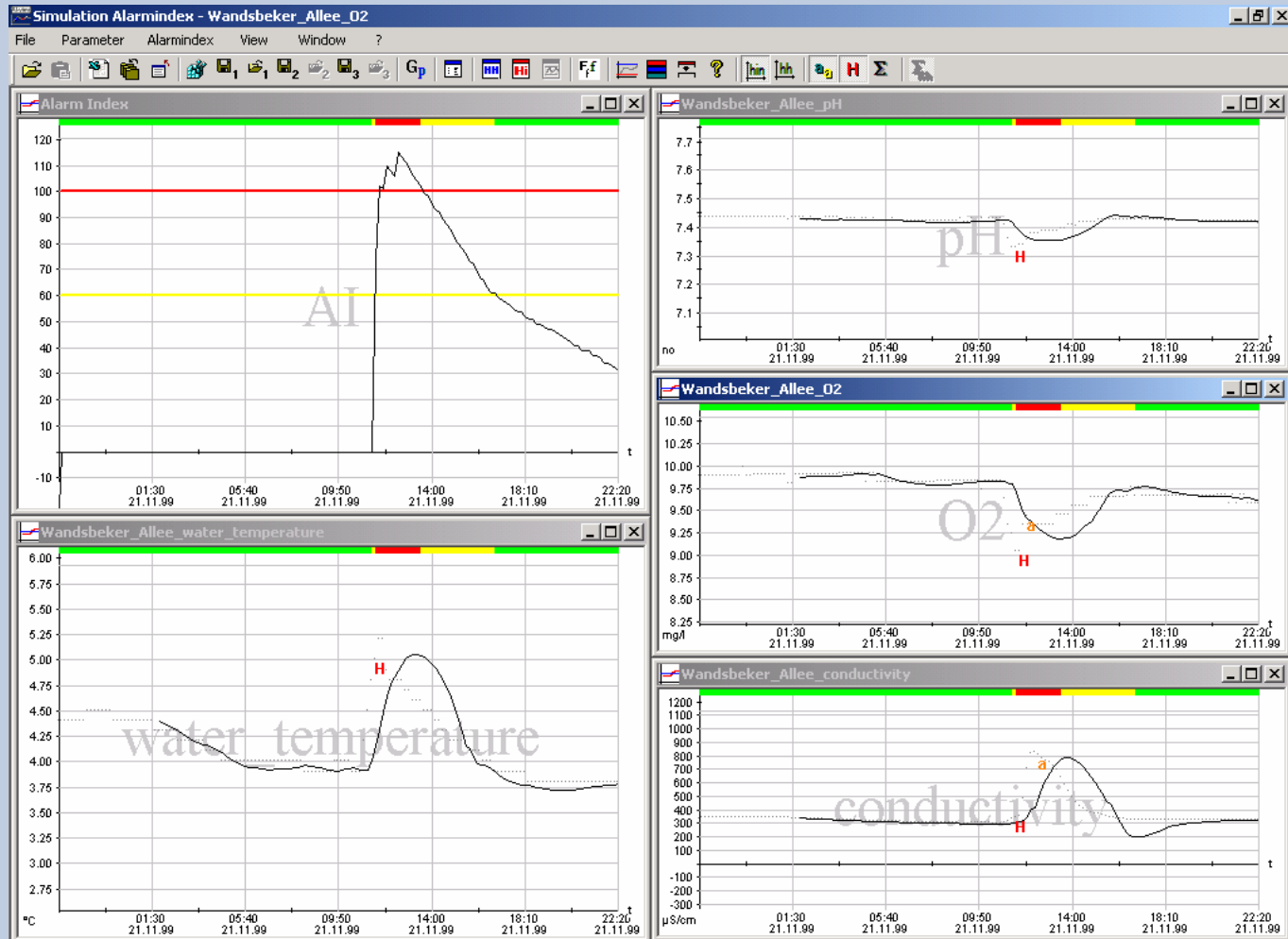
<i>evaluation parameters (examples)</i>		<i>sum</i>	
conductivity	—	40 →	<div>Alarm Index threshold=100</div>
redox potential	—	40 →	
temperature	—	10 →	
pH	—	30 →	
oxygen	—	20 →	
lower limit oxygen	—	30 →	
decreased conductivity	—	blocks →	



# Composition of the Alarm Index (AI) (3)

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Sat 20.11.99 23:58:04: 7.340 no

1: Creek measurands after incubation of toxic substance





# Conclusions

- **Quality assurance is essential and increases acceptance**
- **Periodic checks increase operational availability and reliability**
- **Comparability of monitoring is enhanced by consent of parameters**
- **Including different parameters beside biomonitoring enhances quality of alarm recognition**